PETROLOGIC ANALYSIS OF SHALLOW MARINE, LOWER CRETACEOUS, EDWARDS LIMESTONES, IN THE OHIO STATE SEDIMENTARY ROCK COLLECTION

Senior Thesis

Presented in Partial Fullfillment of the Requirements for the Degree Bachelor of Science.

by

Eric A. Shives

The Ohio State University

1980

____

Advisor

Department of Geology

and Mineralogy

Acknowledgements

I would like to thank the following people: Dr. Kenneth O. Stanley, my advisor for this project, for his invaluable advice and instruction concerning numerous aspects of the study; Dr. Rodney Tettenhorst, for showing me how to obtain and interpret X-ray diffraction information; and Mrs. Margery Tibbetts, for her help in locating the literature that I required to conduct this study.

TABLE OF CONTENTS

LIST OF FIGURES

Figure

Introduction

During the year of 1979, I conducted a petrologic study of Lower Cretaceous limestones and accompanying thin sections which were lent to me by Dr. Kenneth O. Stanley. This suite was examined with the intent that it be presented in a carbonate petrology lab as an exercise in determining depositional models. Thin section descriptions, petrographic classifications, and interpretations of original depositional environments are presented here for use as rough guidelines and reference in conducting a lab study of this suite. Some of the hand specimens have been sawn and polished where megascopic examination was found to be of help. X-ray diffraction was utilized in analysis of specimens suspected to be of dolomitic composition.

The Edwards Formation For Use As A Lab Suite

The Edwards Formation contains diverse lithofacies derived from highly diverse depositional environments. These depositional environments are reflected in the texture, composition, fabric, and fauna of the rock. The wide variety of lithofacies are excellent indicators of the numerous depositional environments to be found on a carbonate shelf. The lack of terrigenous clastics in the Edwards Formation permits determination of depositional models based primarily on carbonate allochems, textures, and fabrics. The lack of terrigenous clastics makes this suite of Edwards limestones excellent for use in a carbonate petrology lab, as extensive knowledge of the petrology of terrigenous clastics is unnecessary.

Preliminary Discussion of
the Edwards Formation

Lower Cretaceous continental shelf deposits in Texas are represented by several sequences that represent transgressive-regressive cycles. The Fredericksburg carbonate sequence is one of these transgressive-regressive units (Moore, 1969, p. 6). The emergent phase of the Fredericksburg sequence is represented by the Edwards Formation. The Edwards Formation was deposited under shallow, high energy, clear marine conditions (Moore, 1969, p.9). The lithofacies within the Edwards Formation are highly diverse and were influenced and controlled by previous structural features (Moore, 1969, p. 11, 13). The Edwards is a fairly pure limestone, generally containing less than one percent terrigenous clastics. The lack of terrigenous clastics in the Edwards is due to structurally positive features, such as the Concho Arch, which blocked influx of terrigenous clastics (Moore, 1969, p.13), and carbonate production rates greatly exceeding the rate of terrigenous clastic supply.

The continental shelf edge, during deposition of the Lower Cretaceous sequence, was sixty miles southeast of San Antonio and trended northeast (Moore, 1969, p. 4-5). The shore at this time was north of Abilene (Moore, 1969, p.4).

The diverse lithofacies of the Edwards Formation indicate numerous and diverse depositional environments. The following factors were considered while constructing depositional models of these limestones:

1) Grain size, rounding, and coatings on grains. These features are partial indicators of the original energy regime (Wilson, 1975, p. 13).

2) The effects of gravity in transporting allochems and clasts. This is particularly significant in reef flank deposits where reef derived allochems collect downslope as a talus (Newell, 1953, p.11).

3) Presence or absence of lime mud. This feature is an indication of the original energy regime and currents of removal (Dunham, 1962).

4) The effects of highly variant and extreme salinities, attained in restricted environments, upon faunal diversity, faunal abundance, and allochem composition (Lucia, 1972). In these restricted environments, faunal diversity is low, and marine organisms are often scarce. The composition of allochems is often dolomitic, and gypsum is often present. These features reflect the hypersaline nature of the waters in which these allochems were deposited.

5) Grain types, which due to the fundamentally autocthonous nature of carbonate grains, reflect the environmental conditions during deposition (Wilson, 1975, p. 7, 18).

6) The effects of neomorphism (Bathurst, 1971, p. 475), cementation (Bathurst, 1971,p.415), and solution (Wilson, 1975, p. 19) in altering the original fabric and porosity. Hence, conclusions of the original depositional environment must be derived by interpretations of what the original fabric and porosity appears to have been.

In Figure 1, I have constructed a diagram of depostional environment models and correlated them with lithofacies and lithologic features. Please bear in mind that Figure 1 does not necessarily represent the original lateral distribution or relative abundance of these environments.

Although the data on the collection sites of these limestones is insufficient for determining their positions relative to each other, they probably fit into a paleogeographic setting similar to that in Figure 2.

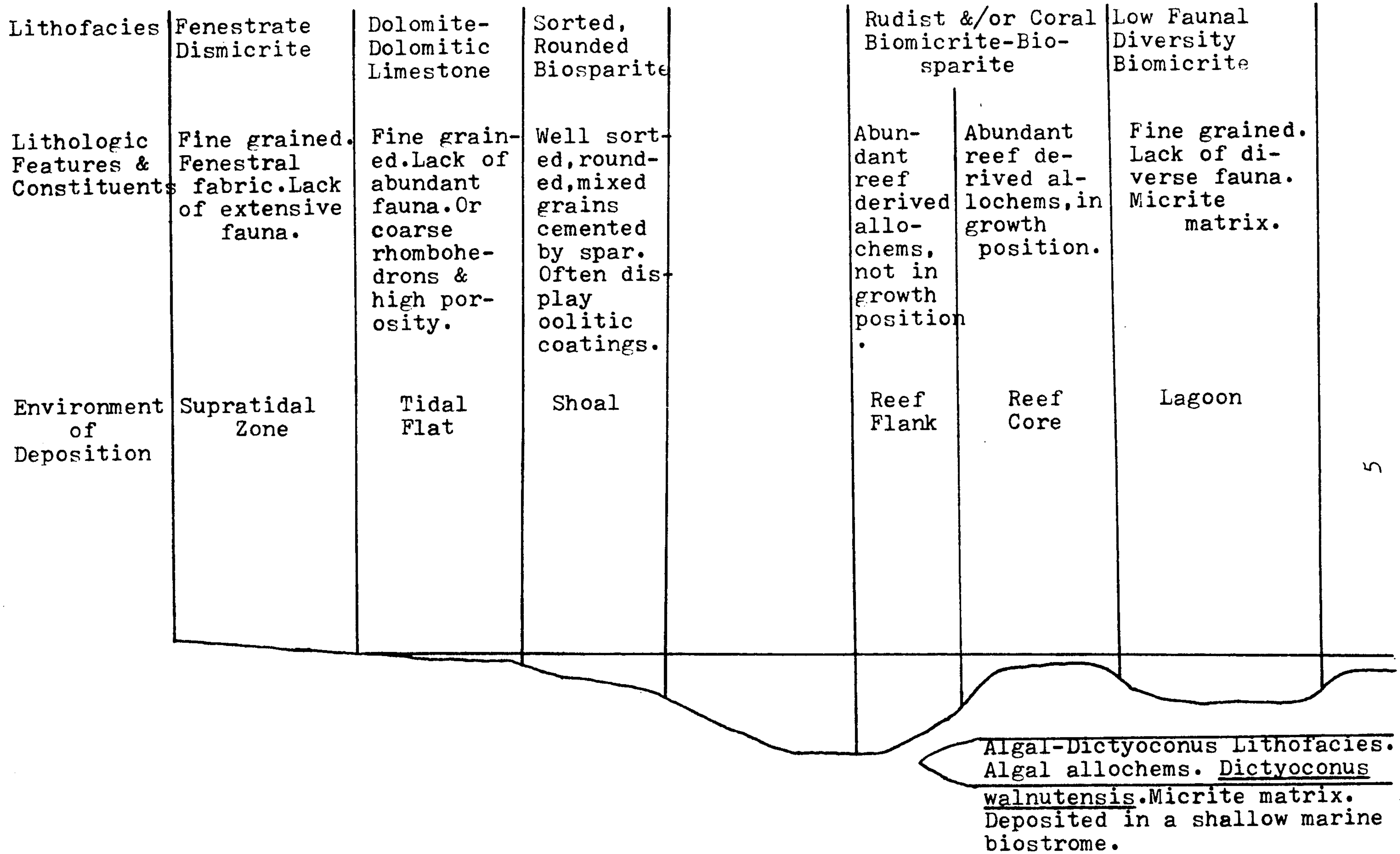

Lithofacies
Fenestrate Dismicrite
Dolomite-Dolomitic Limestone
Sorted, Rounded Biosparite
Rudist &/or Coral Biomicrite-Bio-sparite
Low Faunal Diversity Biomicrite
Lithologic Features & Constituents
Fine grained. Fenestral fabric. Lack of extensive fauna.
Fine grain-ed. Lack of abundant fauna. Or coarse rhombohe-drons & high por-osity.
Well sort-ed, round-ed, mixed grains cemented by spar. Often dis-play oolitic coatings.
Abun-dant reef derived allo-chems, not in growth position.
Abundant reef de-rived al-lochems, in growth position.
Fine grained. Lack of di-verse fauna. Micrite matrix.
Environment of Deposition
Supratidal Zone
Tidal Flat
Shoal
Reef Flank
Reef Core
Lagoon
Algal-Dictyoconus Lithofacies. Algal allochems. Dictyoconus walnutensis. Micrite matrix. Deposited in a shallow marine biostrome.

Figure 1.

LEGEND

Fenestrate Dismicrite

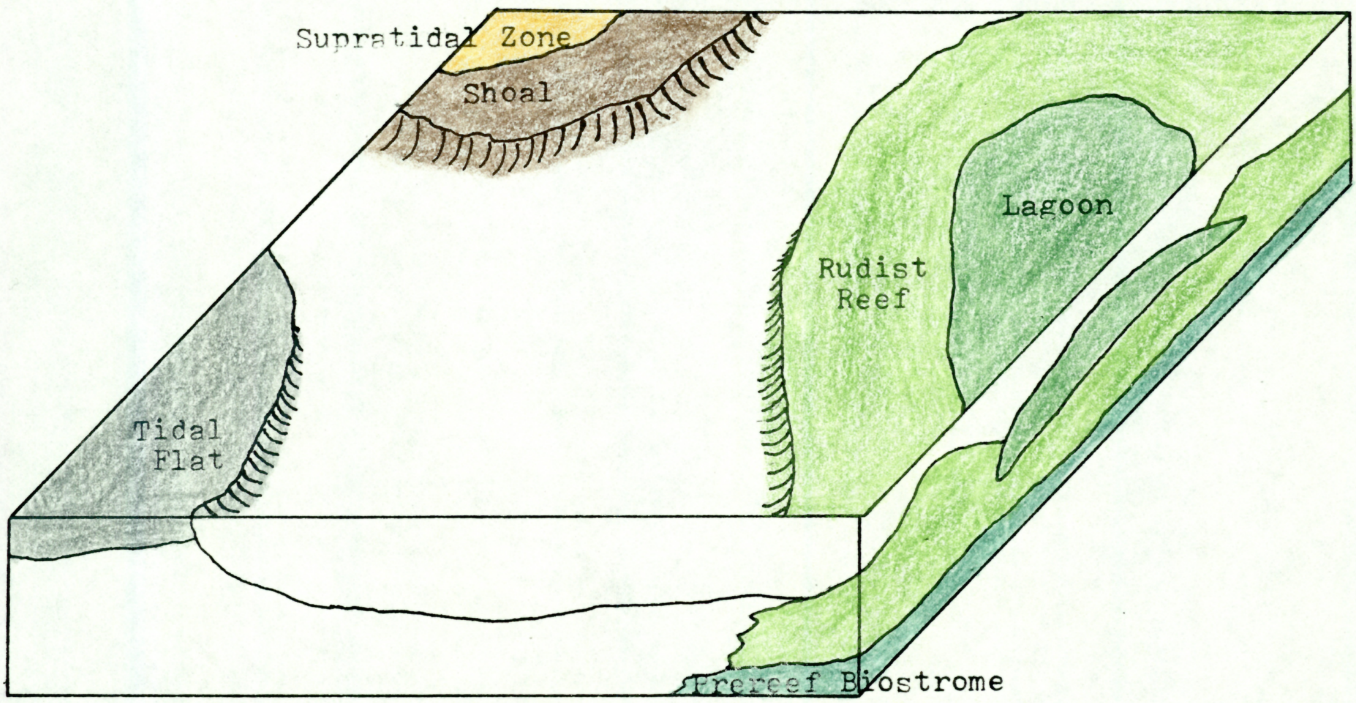
Dolomite-Dolomitic Limestone

Sorted, Rounded Biosparite

Algal-Dictyoconus Biomicrite

Low Faunal Diversity Biomicrite

Rudist &/or Coral Biomicrite-Biosparite



IDEALIZED RECONSTRUCTION OF PALEOGEOGRAPHY
AND LITHOFACIES DURING DEPOSITION OF
THE EDWARDS FORMATION

Figure 2.

Discussion of Lithofacies

The rock types found in this suite of limestones may be placed in one of the following divisions of lithofacies:

Fenestrate Dismicrite Lithofacies

This lithofacies is composed of dismicrites which contain spar filled birdseye srtuctures in a micrite matrix. Fauna is sparse and of low diversity in this rock type. When fossil allochems are present they are usually small ostracods and forams. Fine lamina and dessication cracks are often present in this lithofacies (Shinn, 1968).

This rock type is produced from supratidal and (sometimes) intertidal sediments. Sporadic flooding and tides subject these sediments to alternate intervals of wetting and drying. This causes differential contraction between quickly drying and shrinking surface sediments and wet subsurface sediments producing planar vugs (Shinn, 1968). Air contained in supratidal sediments rises and forms bubbles when covered by almost fluid sediments during flooding. This trapped air is subsequently preserved as spherical vugs as the sediment hardens during subariel exposure (Shinn, 1968).

This lack of marine fauna and faunal diversity in this lithofacies is due to deposition in a primarily subariel environment.

Specimens BZF and EPC-2 are examples of Fenestrate Dismicrite Lithofacies.

Algal-_Dictyoconus_ Biomicrite Lithofacies

This lithofacies is composed of biomicrites which contain mixed grains of algae, forams, ostracods, echinoids, pelecypods, gastrapods in a micrite matrix. Algae allochems associated with the foram _Dictyoconus walnutensis_ are the index fossils denoting this lithofacies (Wilson, 1975, p. 27).

The benthonic foram _Dictyoconus walnutensis_ and green algae allochems are found in early reef (Marcantel, E., 1969, p. 31) and reef flank (Nelson, 1959) deposits. The early reef in the Edwards developed as a biostrome in a shallow marine environment of probably no more than ten feet in depth (Marcantel, E., 1969, p. 29). In this environment green algae and forams (especially Miliolids and _Dictyoconus_) thrived (Marcantel, E., 1969, p. 29).

Specimen EOV-2 is an example of the Algal-_Dictyoconus_ Biomicrite Lithofacies.

Rudist and/or Coral Biomicrite-Biosparite Lithofacies

This lithofacies which is composed of biomicrites and biosparites, contains numerous reef derived allochems such as rudists and corals. Micrite matrix, spar cement, or both are present in this lithofacies depending on the energy regime of the depositional environment. Massive organic structures and open framework with roofed cavities are often present in this lithofacies (Wilson, 1975, p.27).

These rock types are a product of reef flank and reef core deposits. Abundant reef forming allochems, found in these rocks, usually show little evidence of rounding or sorting. Presence of spar or micrite in these rock types is a function of energy regime which in turn is a partial function of depth. Upper reef core deposits, which often protrude into wave base, are primarily cemented by spar, lime muds having been winnowed out. In deeper water reef flank deposits, micrite matrix predominates, as a binding agent.

Reef forming allochems bound in growth position usually indicate a reef core deposit. This feature is often discernible in hand specimens but seldom in thin sections.

Examples of Rudist and/or Coral Biomicrite-Biosparite Lithofacies, are specimens ADP, ADO, BVO, BUM, ADR, ADQ, EPA, BZY, EOZ-1, and AMG.

Sorted, Rounded, Biosparite Lithofacies

This lithofacies is composed of biosparites which contain well mixed, rounded, sorted, grains of rudists, forams, echinoids, coral, ostracods, algae, intraclasts, peeloids, gastropods, grapestone, and ooliths, cemented by spar. The grains often display thin oolitic coatings. Small and large localized cross-bedding is often present in this lithofacies (Boutte, 1969).

This rock type is produced in the high energy environment of a shoal. Here, wave turbulence and tidal currents serve to round and sort grains. Grain types found in this lithofacies are well mixed and diverse due to transport and diversity of fauna and flora indigenous to this environment. High water energy over a shoal inhibits deposition of lime muds and encourages cementation by spar. Grains in this rock type often display oolitic coatings. Tidal currents and wave agitation of the grains in water saturated with respect to $CaCO_3$ cause precipitation of aragonite onto the grains, thus forming ooliths (Newell, 1960).

Examples of Sorted, Rounded, Biosparite Lithofacies are specimens BZH, BZG, and AJY.

Dolomite-Dolomitic Limestone Lithofacies

This lithofacies is composed of dolomites and dolomitic limestones which are either fine grained and lacking in fauna or are composed of coarse rhombohedrons with high porosity and are absent of fauna. The fine grained dolomites often display lamina, nodules, mud cracks, and burrows(Marcantel, J., 1969, p. 83).

These rock types are produced on and adjacent to tidal flats. In the shallow, frequently subariel, environment of a tidal flat, water circulation is restricted and the rate of evaporation is high. High salinities are attained which lead to precipitation of gypsum and aragonite. This causes a rise in the $Mg^{2+}Ca^{2+}$ ratio in the water. This leads to primary dolomitization of the fine aragonite sediments (Bathurst 1971,p541). The scarcity and lack of diversity of marine allochems in these primary dolomites is due to frequent subariel exposure and the presence of hypersaline waters.

The lithofacies adjacent to tidal flats are subject to secondary dolomitization through reflux and evaporative pumping of hypersaline waters (Bathurst, 1971, p.532).

Examples of Dolomite-Dolomitic Limestone Lithofacies are specimens AFL, AHR, AFP, and AFC.

Low Faunal Diversity Biomicrite Lithofacies

This lithofacies is composed of biomicrites which contain fossil allochems,that may be abundant but are of low diversity, in a micrite matrix. Grain types found in this lithofacies are forams, sponge spicules, ostracods, and peeloids. This lithofacies often contains lamina (Wilson, 1975, p.69).

This rock type is produced in lagoons. In the protected low energy environment of a lagoon, fine carbonate sediments, brought in by storms and tidal currents, are trapped and produce thick lime mud deposits(Wilson, 1975 p. 6). In situ accumulation of lime muds is also occuring here.

The barrier effect of a lagoon in restricting water circulation results in variable and extreme salinities within(Wilson, 1975,p.60). Extended evaporation will produce hypersaline waters then a sudden storm may reduce salinities. This limits the fauna and flora to those which are tolerant of a high range of salinities. Thus while flora and fauna found in these deposits may be abundant it is usually of low diversity (Wilson, 1975,p.359).

Examples of Low Faunal Diversity Biomicrite Lithofacies are specimens BZW and BZJ.

Fauna Unique to the Cretaceous

The following are shallow marine fauna which originally evolved during the early Cretaceous.

Dictyoconus walnutensis

Dictyoconus walnutensis is a thick walled benthonic foram of the Cretaceous, which is easily recognized in thin section. Marcantel (1969,p. 31) states that rudist reefs would develop over a pre-reef facies which consisted of algae and Dictyoconus fragments in a micrite matrix. This pre-reef facies usually was deposited at shallow depth, as a biostrome, below wave base. The ability to recognize Dictyoconus walnutensis in thin section is of help in constructing depositional models. (See figures 3 and 4 for thin section photographs of Dictyoconus walnutensis.)

Rudists

Rudists are thick shelled pelecypods which have one valve attached or resting on the substrate and the other serving as a cap or lid. In the early Cretaceous rudists radially evolved into many genera and adapted to and flourished in many marine environments (Wilson,1975, p.319).

Rudists contributed immense volume to Cretaceous mounds and reefs. Abundance of rudist and/or rudist fragments in Edwards limestone usually indicates a reef or reef flank lithofacies.

Rudist morphology shows a similar response to energy regimes that many sessile marine organisms do. In high energy regimes short thick walled rudists with long slender shells predominated (Wilson, 1975,p. 319).

Rudists were not colonial and developed as individuals, however, in favorable environments rudists grew in close proximity with their shells often intertwined and attached to one another as well as the substrate. In this manner rudists formed as rigid and substantial a framework as a coral reef and were wave resistant (Wilson, 1975, p. 325). In quiet water environments, some forms grew up to four feet in length (Wilson, 1975, p. 319).

The shell structure of rudists varies with genera, ranging from:

1) Laminar structure similar to many other pelecypods.
2) Prismactic.
3) Cellular.
4) Containing great porosity.
5) Combinations of all the preceeding.

Rudists are megafossils and identification of rudist genera in thin section is often difficult if not impossible. However, general recognition of rudist allochems in thin sections is relatively easy and will aid in constructing depositional environment models. (See Figures 5,6, and 7 for thin section photos of rudist allochems.)

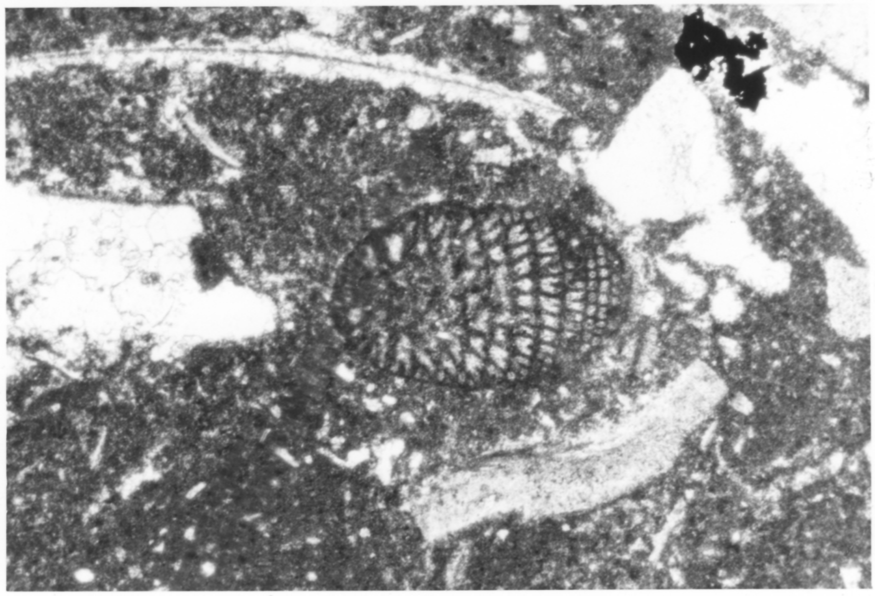


Figure 3. Dictyoconus walnutensis.

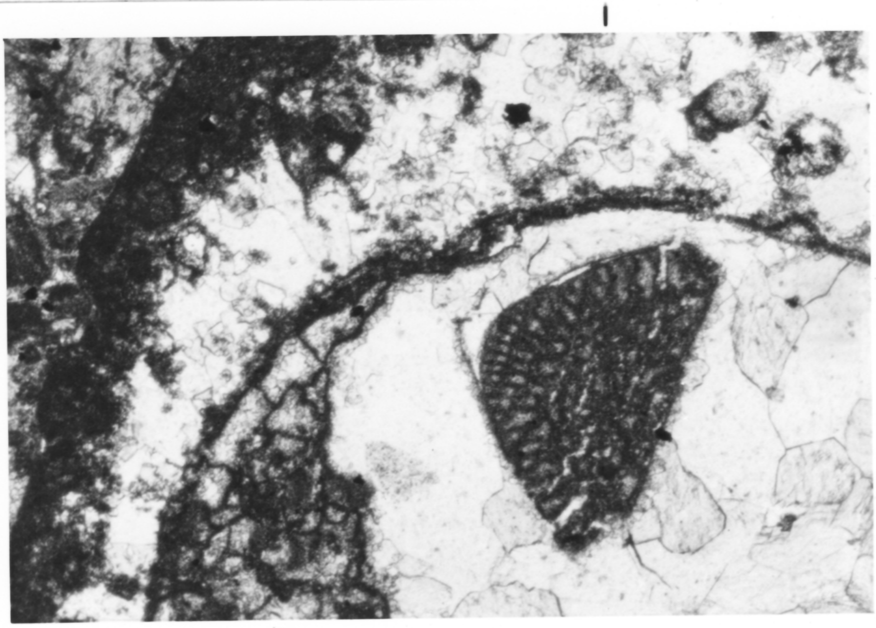


Figure 4. Dictyoconus walnutensis surrounded by a rudist which has recrystallized to spar.

Figure 5. Rudist fragment.

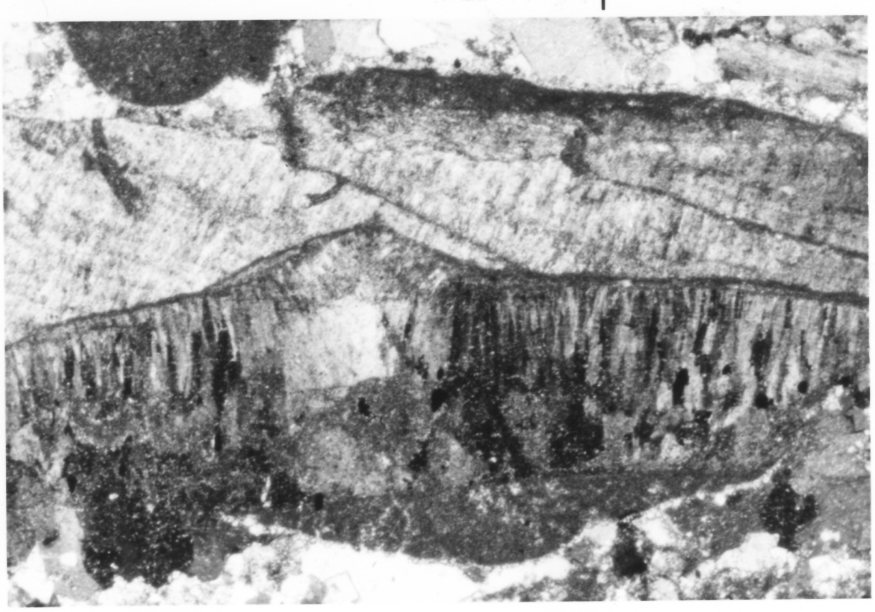


Figure 6. Rudist fragment displaying prismatic structure.

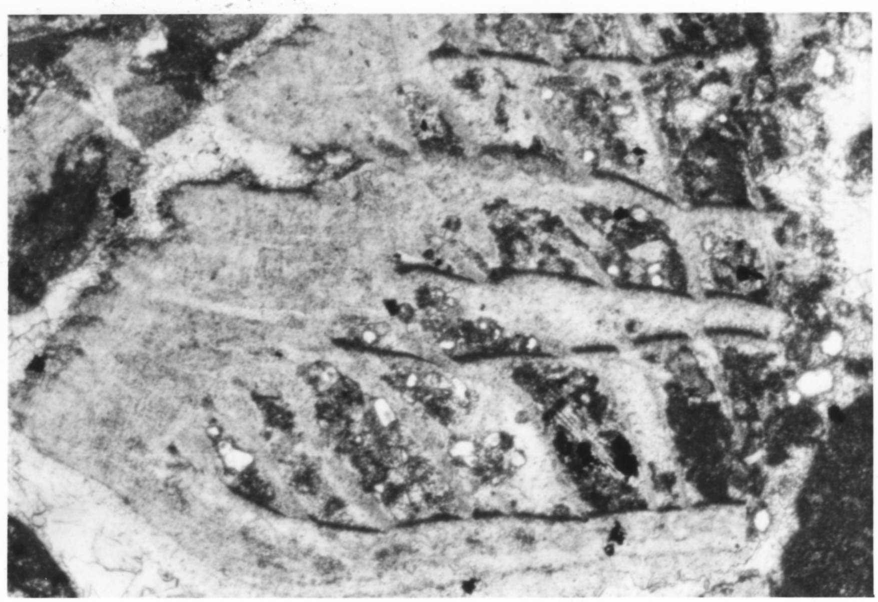


Figure 7. Rudist fragment displaying cellular structure.

Discussion of Specimen Reports

The remainder of this thesis consists of thin section descriptions, classifications, interpretations of depositional environments, and features useful in depositional environment modeling of this suite of Lower Cretaceous Edwards Limestones. I have presented this data in the following format and have grouped it by original depositional environment.

Specimen Name

List of Allochems and Clasts

Fossil Allochems
Non-Fossil Allochems
Clastics
Cement and/or Matrix

Thin Section Description

Special Features Used in
Constructing a Depositional Model

Classification

Discussion and Conclusion of
Probable Depositional Environment

X-ray Diffraction Results (if any)

The classifications applied to these specimens are based on the system devised by Folk (1959) used with modifying adjectives. An example classification and translation of the system used is as follows:

Light gray,	unsorted,	coarse,	Rudist,	Biosparite.
Color	General texture includes sorted, poorly washed, rounded, packed	Specific average size of allochems	Predominant allochem	Type of allochem; Binding agent

Segments of this classification system have been omitted if inapplicable to that particular specimen.

EOZ-2

ALLOCHEMS & CLASTS

Forams

Ostracods

Echinoid plates

Pelecypod fragments

Quartz

Feldspar

Micrite

THIN SECTION DESCRIPTION- Yellowish white, highly porous, limestone of forams and unrounded, poorly sorted quartz and feldspar clasts in a micrite matrix. The forams are highly micritized and show high intragranular porosity. There are also numerous empty vugs which were originally fossil allochems.

SPECIAL FEATURES- Abundant feldspar and quartz clasts. Micrite matrix.

CLASSIFICATION- Yellowish white, porous, packed, foram, Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Micrite matrix indicates a low energy environment. Abundant quartz and feldspar clasts indicate proximity to a clastic source. This specimen was deposited below wave base and probably on or adjacent to a structurally positive feature (such as an arch or a dome) which was blocking an influx of terrigenous clastics.

EVO-2

ALLOCHEMS & CLASTS

Forams

Ostracods

Dictyoconus walnutensis

Gastropods

Dasycladaces algae

Echinoid plates

Intraclasts

Chert

Spar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of forams, gastropods, and dasycladacean algae in a micrite matrix. The algae allochems have all recrystallized to spar.

SPECIAL FEATURES- Presence of *Dictyoconus walnutensis* and algae allochems. Micrite matrix.

CLASSIFICATION- Light gray, packed, algae-foram Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The micrite matrix indicates a low energy environment. The presence of *Dictyoconus walnutensis* and algae allochems is an excellent indication of a pre-reef biostrome which was deposited in a shallow, clear marine environment below wave base.

BZF

ALLOCHEMS & CLASTS

Ostracods

Forams

Spar

Micrite

THIN SECTION DESCRIPTION- White limestone of irregular spar filled vugs in a micrite matrix. Some of the vugs are up to one half cm. in length, however the majority are one mm. or less in length.

SPECIAL FEATURES- Lack of fauna. Fenestral fabric.

CLASSIFICATION- White Dismicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The fenestral fabric of spar filled vugs in a micrite matrix is produced by alternate wetting and drying. Frequent subariel exposure accounts for the lack of marine fauna. This is a supratidal deposit.

EPC-2

ALLOCHEMS & CLASTS

Forams

Ostracods

Spar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of numerous spar filled vugs and cracks in a micrite matrix. Vugs vary in length from one half cm. to one fourth mm. Forams and ostracods are also present but are highly micritized and difficult to distinguish.

SPECIAL FEATURES- Lack of diverse fauna. Fenestral fabric.

CLASSIFICATION- Light gray Dismicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The fenestral fabric indicates an environment of alternate wetting and drying. Presence of numerous forams would indicate that at times the depositional environment was submerged. This specimen was probably deposited in the upper part of the intertidal zone or lower supratidal zone.

BZW

ALLOCHEMS & CLASTS

Echinoid plates

Forams

Dictyoconus walnutensis

Ostracods

Sponge spicules

Spar

Micrite

THIN SECTION DESCRIPTION- Light olive gray limestone of fine sponge spicules and spar filled vugs in a micrite matrix. The spar filled vugs appear to be recrystallized fossil allochems. Part of the specimen is totally recrystallized to spar, leaving only the larger allochems unaltered. The spar-micrite matrix border is bounded by a reddish brown cementation front.

SPECIAL FEATURES- Micrites matrix. The abundance of sponge spicules. Lack of diverse fauna.

CLASSIFICATION- Light olive gray, packed, spiculitic Biomictite.

PROBABLE DEPOSITIONAL ENVIRONMENT - Micrite matrix indicates a low energy environment. Lack of diversity of fauna indicates a restricted environment. This is a lagoonal deposit.

BZJ

ALLOCHEMS & CLASTS

Echinoid plates

Forams

Pelecypods

Ostracods

Peeloids

Spar

Microspar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of predominantly peeloids and flattened peeloids in a micrite matrix. This specimen shows a marked lack of fossils. The fossil allochems present have been micritized. Numerous empty vugs and small patches of microspar are present.

SPECIAL FEATURES- Lack of abundant and diverse fauna. Extremely fine grain size. Micrite matrix.

CLASSIFICATION- Light gray Pelmicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The lack of fauna and low diversity of fauna indicates a restricted environment of extreme or variant salinities and possibly high temperatures. Fine grain size and micrite matrix indicates a low energy environment. This is a lagoonal deposit.

AJY

ALLOCHEMS & CLASTS

Forams

Echinoid plates

Pelecypod fragments

Green algae

Ostracods

Peeloids

Ooliths

Spar

Microspar

THIN SECTION DESCRIPTION- Light gray limestone of fine, well sorted, rounded grains cemented by spar. The grains consist of mixed peeloids, ooliths, forams, and pelecypod fragments. Many of the grains display an oolitic coating. The majority of the grains are micritized, and many show partial to complete dissolution of the grain interior.

SPECIAL FEATURES- Rounding and sorting of grains. Spar cement. Oolitic coatings on many grains.

CLASSIFICATION- Light gray, sorted, rounded, fine, Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Sorting and rounding of grains and spar cement indicate a high energy environment. The oolitic coatings indicate extensive agitation. This is a shoal deposit.

BZG

ALLOCHEMS & CLASTS

Forams

Rudists

Gastropods

Echinoid plates

Green algae

Peeloids

Intraclasts

Grapestones

Spar

Micrite

THIN SECTION DESCRIPTION- White limestone of fine to medium, sorted grains,which are predominantly forams, cemented by spar.This specimen contains areas of micrite matrix which have a semiplanar border with those grains cemented by spar.

SPECIAL FEATURES- Sorting of grains. Predominance of spar cement. Rough gradation of grain size.

CLASSIFICATION- White, sorted, poorly washed, foram Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Sorting of grains and spar cement indicate a high energy environment. rough gradation of grain size indicates a changing energy regime. This is a shoal deposit which was possibly significantly affected by tides.

BZH

ALLOCHEMS & CLASTS

Forams
Gastropods
Pelocypod fragments
Echinoid plates

Peeloids
Intraclasts
Ooliths

Spar
Microspar
Micrite

THIN SECTION DESCRIPTION- Very light gray limestone of fine sorted and rounded peeloids and forams in a spar-microspar cement. Most of the grains are micritized and many display oolitic coatings. Also present are very large angular micritic intraclasts, none of which display oolitic coatings.

SPECIAL FEATURES- Sorting and rounding of grains. Spar cement. Oolitic coatings.

CLASSIFICATION- Light gray, sorted, rounded, fine, Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Sorting and rounding of grains and spar cement indicate a high energy regime. Oolitic coatings indicate a good deal of agitation. Note that the very large angular clasts which were probably too heavy for significant agitation, do not display an oolitic coating. This is a shoal deposit.

AFC

ALLOCHEMS & CLASTS

Very fine crystals

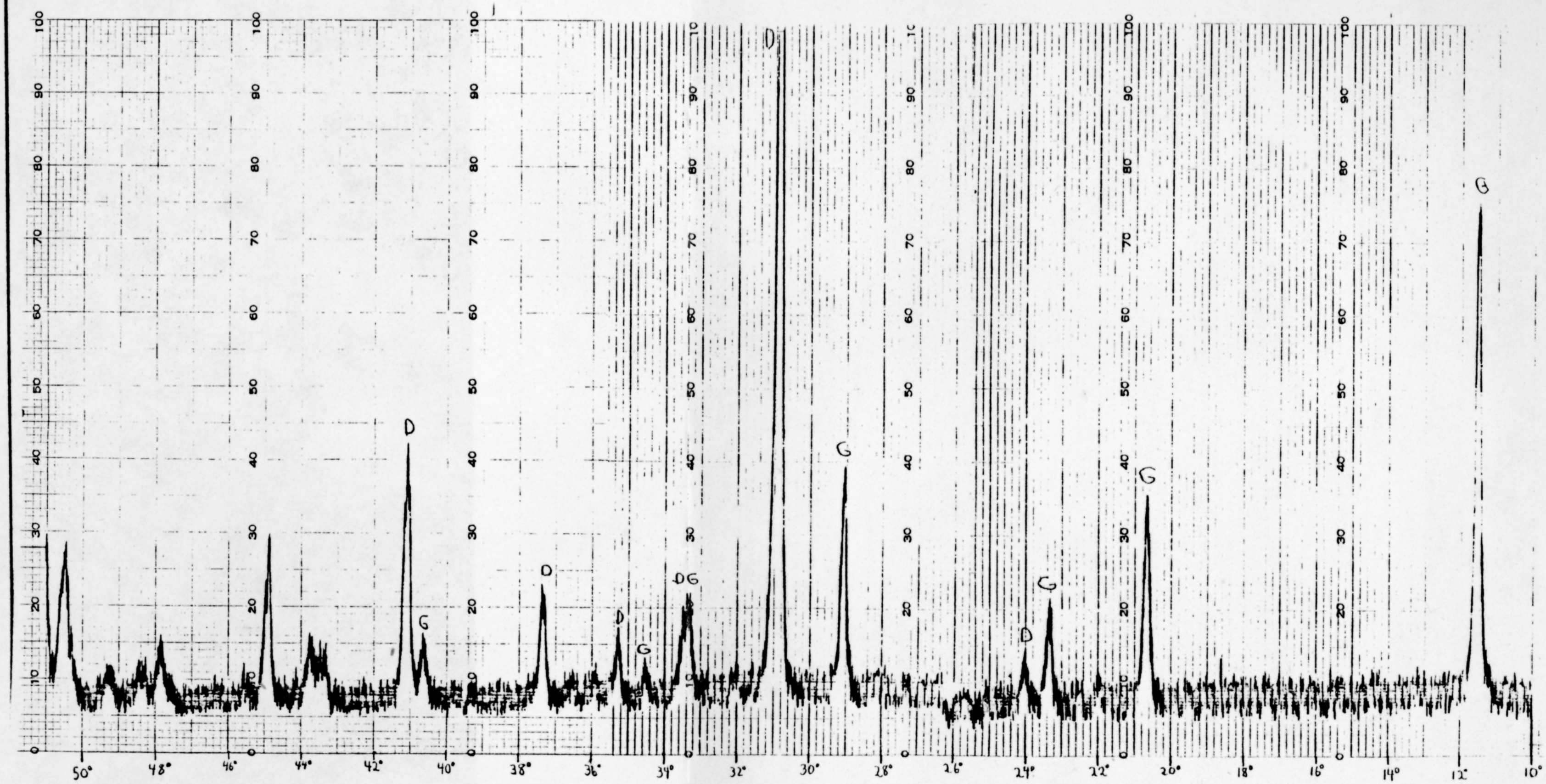
Gypsum

THIN SECTION DESCRIPTION- Light gray, laminated dolomite of very fine interlocking subhedral crystals. Shows traces of gypsum.

SPECIAL FEATURES- Lack of fossils. Gypsum trace. Fine grain size.

CLASSIFICATION- Light gray, laminated, fine Dolomite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Fine grain size indicates a low energy environment. Lack of fossils and the presence of gypsum indicates a restricted and highly saline environment. This is a tidal flat deposit.



AFO

CuKα λ=1.54178 A°

AFP

ALLOCHEMS & CLASTS

Fine interlocking crystals

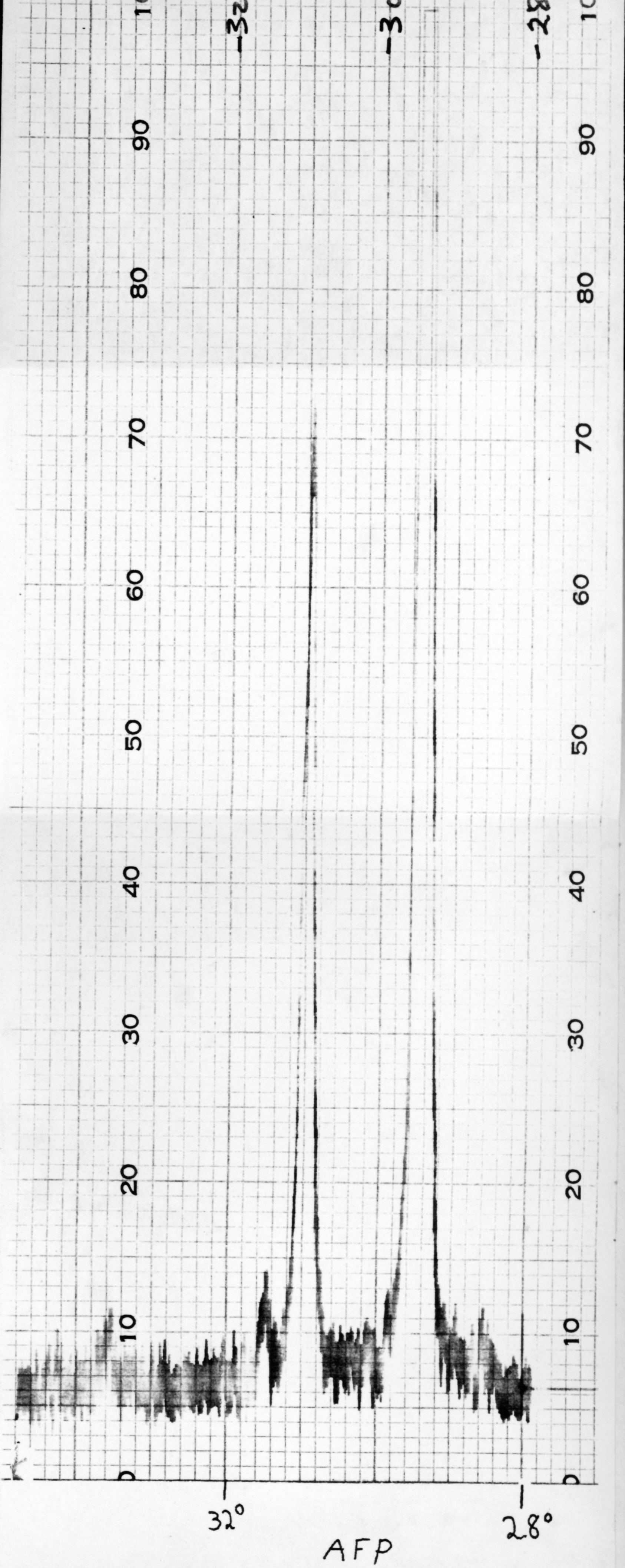
Gypsum

THIN SECTION DESCRIPTION- Grayish yellow dolomite of extremely fine grains containing numerous, small, spar filled and empty vugs and cracks. A nodular fabric is apparent in the hand specimen but is difficult to detect in the thin section.

SPECIAL FEATURES- Total absence of fauna. Fine grain size.

CLASSIFICATION- Grayish yellow, fine grained, nodular Dolomite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Total absence of fauna and fine grain size indicate a restricted, low energy environment. This is a primary dolomite deposited on a tidal flat.



AFP

CuK α $\lambda = 1.54178$ A°

AHR

ALLOCHEMS & CLASTS

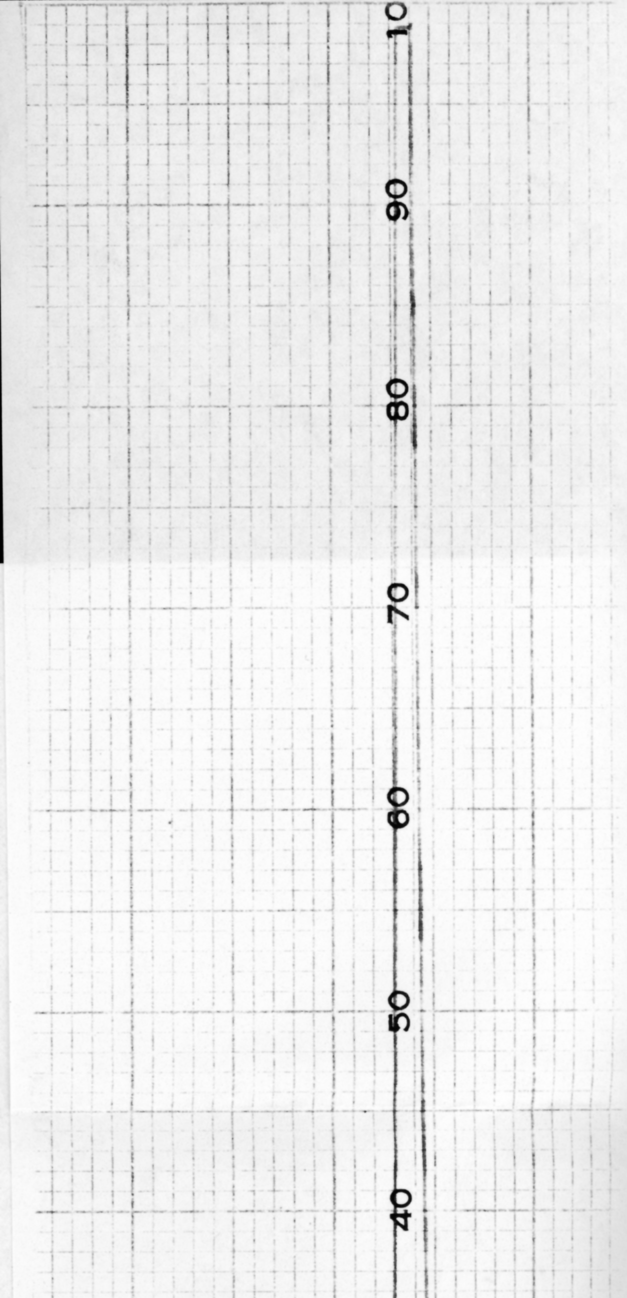
Coarse euhedral rhombs of dolomite

THIN SECTION DESCRIPTION- Grayish orange dolomitic limestone, of coarse euhedral rhombs, displaying high intergranular porosity.

SPECIAL FEATURES- Coarse, well formed rhombs.

CLASSIFICATION- Grayish orange, porous, coarsely crystalline Dolomite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The coarse euhedral rhombs indicate that this is a secondary dolomite produced by reflux dense hypersaline brines of a tidal flat through facies adjacent to it.



AHR

CuKα $\lambda = 1.54178$ Å

AFL

ALLOCHEMS & CLASTS

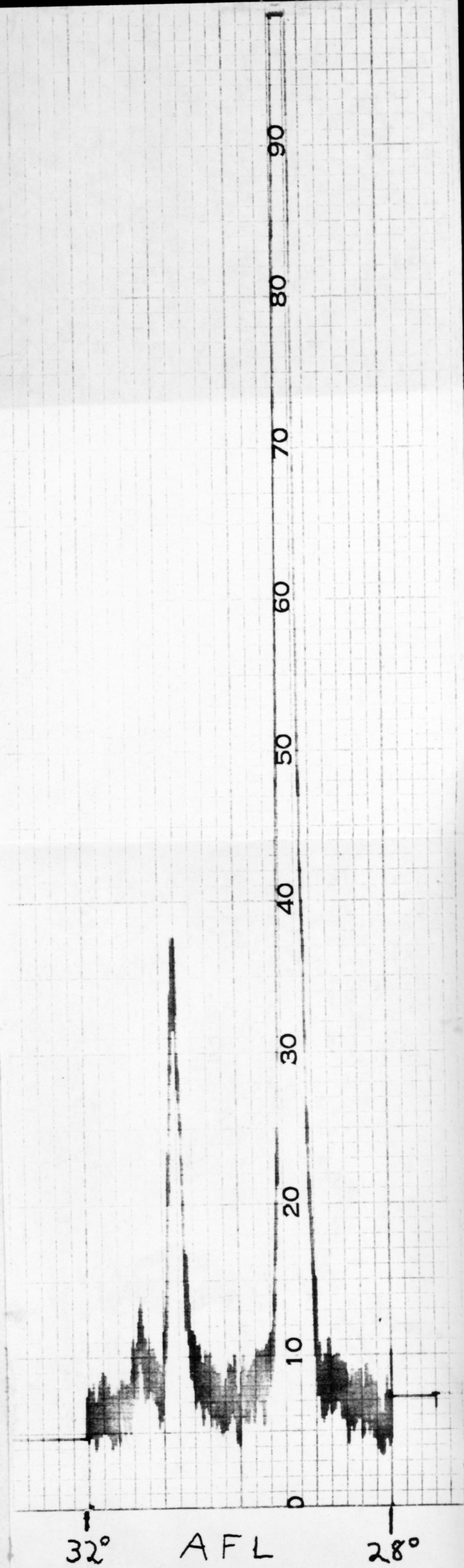
Dolomite rhombs

THIN SECTION DESCRIPTION- Light gray dolomitic limestone of coarse euhedral rhombs. Displays high intercrystalline porosity of approximately twenty eight percent.

SPECIAL FEATURES- Coarse euhedral rhombs. Absence of fossil allochems.

CLASSIFICATION- Light gray, porous, coarsely crystalline Dolomite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The coarse euhedral rhombs indicate that this is a secondary dolomite, produced by reflux or evaporative pumping of the hypersaline brines of a tidal flat through the facies adjacent to it.



32° AFL 28°

CuK α λ=1.54178 A°

ADP

ALLOCHEMS & CLASTS

Rudists

Scleractinian corals

Echinoid plates

Ostracods

Sponge spicules

Spar

Microspar

Micrite

THIN SECTION DESCRIPTION- White limestone of poorly sorted, unabraded rudists and scleractinian corals in a micrite matrix. Large areas of spar and small patches of microspar are present due to neomorphic recrystallization of fossil allochems, dissolution and recrystallization of the original rock, and precipitation as cement.

SPECIAL FEATURES- Abundant rudists and scleractinian corals. Micrite matrix.

CLASSIFICATION- White, packed Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The abundance of unabraded rudist and scleractinian coral fragments indicate close proximity to a reef. Micrite matrix indicates a low energy environment, and probably deep water environment. This is a reef talus, formed by downslope accumulation of reef allochems, that have been inundated by lime mud.

ADO

ALLOCHEMS & CLASTS

Rudists

Scleractinian corals

Echinoid plates

Spar

Microspar

Micrite

THIN SECTION DESCRIPTION- Yellowish gray limestone of coarse, unsorted, unabraded rudist fragments cemented by microspar. Cementation is both intergranular and intragranular. Note the prominant cellular and prismatic structure of many of the rudist fragments.

SPECIAL FEATURES- Abundant, unabraded rudists. Microspar cement.

CLASSIFICATION- Yellowish gray, unsorted, coarse, rudist Biomicrosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The large, angular nature of the rudist allochems indicate close proximity to the source. Microspar and spar cement indicate a high energy environment. This is a reef core or shallow reef flank deposit.

ADR

ALLOCHEMS & CLASTS

Echinoid plates
Rudists
<u>Dictyoconus walnutensis</u>

Peeloids
Intraclasts

Spar
Micrite

THIN SECTION DESCRIPTION- Light gray limestone of coarse, moderately sorted, unrounded, rudist fragments, <u>Dictyoconus walnutensis</u>, forams, and intraclasts in a spar cement.

SPECIAL FEATURES- Abundance of rudists. Spar cement. Sorting of grains.

CLASSIFICATION- Light gray, coarse, sorted, well washed, Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Abundance of rudist fragments indicates close proximity to a reef. Sorting of grains and coarse grain size along with spar as cementing agent indicates shallow high energy environment. This is a reef talus deposited in a shallow fore reef, quite near wave base.

EOZ-1

ALLOCHEMS & CLASTS

Forams

Sponge spicules

Echinoid plates

Ostracods

Rudists

Oncolites

Chert

Spar

Micrite

THIN SECTION DESCRIPTION- Medium gray limestone of mixed sponge spicules and large unrounded rudist fragments in a micrite matrix. Many of the fossil allochems have recrystallized to spar. The rudists are most easily observed by megascopic examination of the hand specimen rather than in thin section. Large oncolites of alternating laminae of chert and carbonate are also present.

SPECIAL FEATURES- Micrite matrix. Presence of large rudist allochems, (apparent in the hand specimens).

CLASSIFICATION- Medium gray Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Micrite matrix indicates a low energy environment. Presence of abundant rudist megafossils indicates close proximity to a reef. This specimen is a deep water fore reef deposit.

BUM

ALLOCHEMS & CLASTS

Scleractinian Coral

Spar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of coarse to medium subhedral crystals of spar, containing irregular patches and semi parallel wavy belts of micrite. Areas of micrite in thin secion are molds of the original intra-porosity of a Scleractinian coral. The spar is a product of inversion of the corals' skeletal aragonite and cementation.

SPECIAL FEATURES- Large size and intact nature of coral.

CLASSIFICATION- Light gray, coarse, Scleractinian Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The Scleractinian coral is a reef associated fauna. The large size and intact nature of the hand specimen indicates little or no transport has taken place. This specimen was probably deposited in situ and is from the reef core or reef proper.

ADQ

ALLOCHEMS & CLASTS

Rudists

Spicules

Dictyoconus walnutensis

Gastropod steinkern

Box work steinkerns, probably from a rudist

Peeloids

Spar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of coarse, unsorted, unabraded rudist fragments and calcareous spicules in a micrite matrix. Also present is a good deal of spar due to dissolutions and recrystallization, inversion and recrystallization of skeletal grains.

SPECIAL FEATURES- Abundance of rudists. Micrite matrix.

CLASSIFICATION- Light gray, packed, Rudist Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Abundance of coarse angular rudist fragments in a micrite matrix indicates a low energy environment in close proximity to a reef. This specimen is a reef flank deposit. The spar present is a secondary product.

BUO

ALLOCHEMS & CLASTS

Gastropods
Rudists and/or other pelecypods
Echinoid plates

Intraclasts

Quartz

Spar
Microspar

THIN SECTION DESCRIPTION- Gray-white limestone of unsorted pelecypods and gastropods, showing little rounding, in a spar cement. Also contains traces of quartz.

SPECIAL FEATURES- Spar cement. Lack of sorting. Abundant pelecypod fragments.

CLASSIFICATION- Light gray, unsorted Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Abundance of pelecypod fragments indicates a nearby source, probably a rudist reef. Spar cement indicates a high energy environment. This is a shallow reef flank deposit.

EPA

ALLOCHEMS & CLASTS

Scleractinians
Pelecypods

Spar
Micrite

THIN SECTION DESCRIPTION- Light gray limestone of Scleractinian corals and pelecypod fragments in a micrite matrix. All of the fossil allochems have re-crystallized to spar.

SPECIAL FEATURES- Abundance of Scleractanians. Micrite matrix.

CLASSIFICATION- Light gray, Scleractinian Biomicrite.

PROBABLE DEPOSITIONAL ENVIRONMENT- The micrite matrix indicates a low energy environment. The abundance of Scleractinian corals indicates close proximity to a supplying source. This is a deep water fore-reef deposit.

BZY

ALLOCHEMS & CLASTS

Rudists
Echinoid plates

Spar

THIN SECTION DESCRIPTION- Dark gray limestone of large rudists cemented by spar. All fossil allochems have recrystallized to spar, and lost original internal structure. In megascopic examination of this specimen, the binding agent appears to be micrite. The spar cement is probably an aggradational neomorphic product of an original micrite matrix.

SPECIAL FEATURES- Large and abundant rudists. Apparent micrite matrix of hand specimen.

CLASSIFICATION- Dark gray rudist Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Large and abundant rudists indicate a close proximity of a reef. Apparent neomorphosed micrite, would indicate a low energy regime. This is a deep water reef flank deposit.

AMG

ALLOCHEMS & CLASTS

Rudists

Forams

Dictyoconus walnutensis

Echinoid fragments

Peeloids

Chert

Spar

Micrite

THIN SECTION DESCRIPTION- Light gray limestone of mixed rudists, peeloids, and forams bound by both spar and micrite. The grains show no sorting or rounding. Spar is present as an intra and intergranular cement and as a recrystallization product of fossil allochems. Chert is present as a dissolution and replacement product.

SPECIAL FEATURES - Rudist allochems. Absence of sorting or rounding of grains.

CLASSIFICATION- Light gray, poorly washed Biosparite.

PROBABLE DEPOSITIONAL ENVIRONMENT- Abundance of spar cement indicates a moderate to high energy environment, as much of the micrite is probably crushed peeloids. Numerous unsorted, unrounded rudist allochems indicates close proximity to a reef. This is a reef flank deposit.

SUMMARY

This study of Lower Cretaceous Edwards limestones was conducted and presented to be an aid and reference in constructing models of original depositional environments of these specimens. Through petrologic examinations and analysis of these limestones the student has been introduced to and familiarized with:

1) Lower Cretaceous shallow marine fauna.
2) Fabrics and textures of limestones deposited on a carbonate shelf.
3) The numerous and diverse depositional environments which create a carbonate shelf facies.

The fabric, textural, and compositional features of this carbonate facies indicate:

1) All of the lithofacies encountered in this suite of limestones are those types which are deposited in shallow to very shallow marine environments. This is indicated by the fact that the rock types within this suite may be designated as one of the following:
   A. Fenestrate Dismicrite Lithofacies, formed in supratidal zones.
   B. Algal <u>Dictyoconus</u> Biomicrite Lithofacies, formed in shallow marine biostromes.
   C. Rudist and/or Coral Biomicrite-Biosparite Lithofacies, formed in the reef core and reef flank.
   D. Sorted, Rounded Biosparite Lithofacies, formed in shoals.
   E. Dolomite-Dolomitic Limestone Lithofacies, formed in and adjacent to tidal flats.
   F. Low Faunal Diversity Biomicrite Lithofacies, formed in lagoons.
2) The Lower Cretaceous Reefs and surrounding facies in central Texas were greatly influenced by Rudistids, numerous

Rudistids and Rudistid fragments found in the reef core and reef flank deposits indicate that these pelecypods were the primary reef frame builders and contributors of reef material. Numerous small and abraded Rudistid bioclasts found in adjacent lithofacies indicate that Rudistids supplied significant sediments here also through transport from the reefs and by local growth of small isolated Rudistid patches.

3) Abundant lime mud was encountered only in specimens deposited in low energy environments such as tidal flats, lagoons, and deep water fore reefs. Therefore, although lime mud is produced everywhere on a carbonate shelf, deposition and lithification of lime muds occurs only in those environments where currents are insufficient to remove it.

4) Type, diversity, abundance, and texture of fossil allochems are excellent indicators of the environment in which they were deposited. This we have determined through correlation of these features with rock textures, fabrics, and nonfossil allochems indicating a specific depositional environment.

REFERENCES

Bathurst, R. G. C., 1971, Carbonate Sediments and Their Diagenesis: Elsevier Publishing Co., Amsterdam.

Boutle, A. L., 1969, Carbonate-Sand Complex, West Central Texas: Depositional Environments and Depostional History, Lower Cretaceous Shallow Shelf Carbonate Sequence West Central Texas, Dallas Geological Society, AAPG.-SEPM., pp. 40-74.

Lucia, F. J., 1972, Recognition of Evaporite-Carbonate Shoreline Sedimentation: Recognition of Ancient Sedimentary Environments, Soc. Econ. Paleontologists Mineralogists, Spec. Publ., 16, pp. 160-191.

Marcantel, E. Z., 1969, The Skelly Hobbs Rudist Reef Complex: Depositional Environments and Depositional History, Lower Cretaceous Shallow Shelf Carbonate Sequence, West-Central Texas, Dallas Geological Society, AAPG .-SEPM. pp. 19-39.

Marcantel, J., 1969, The Origin and Distribution of Lower Cretaceous Dolomite in West Central Texas: Depositional Environments and Depositional History Lower Cretaceous Shallow Shelf Carbonate Sequence West Central Texas, Dallas Geological Society, AAPG.-SEPM., pp. 75-104.

Moore, C. H., Jr., 1969, Stratigraphic Framework Lower Cretaceous, West-Central Texas: Depositional Environments and Depositional History, Lower Cretaceous Shallow Shelf Carbonate Sequence West-Central Texas, Dallas Geological Society, AAPG.-SEPM. pp. 1-16.

Nelson, H. F., 1959, Deposition and Alteration of the Edwards Limestone, Central Texas: Symposium on Edwards Limestones in Central Texas, Texas Univ. Bull., 5905, pp. 21-95.

Newell, N. D., Rigby, J. K. Fischer, A. G., Whiteman, A. J., Hickox, J. E., Bradley, J. S., 1953. The Permian Reef Complex of the Guadelupe Mountains Region, W. H. Freeman & Co., San Francisco.

Newell, N. D., Imbrie, J., Purdy, E. G., 1960,Bahamian Oolitic Sand: J. Geol., v. 68, pp. 481-497.

Shinn, E. A., 1968, Practical Significance of Birdseye Structures in Carbonate Rocks: J. of Sedimentary Petrology, v. 38, pp. 215- 223.

Wilson, J. L., 1975, Carbonate Facies in Geologic History:
Springer, Verlag Berlin. Heidelberg, New York.